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The elevation of the Zuñi Plateau was attended by the marked bulging or protrusion of limited portions of the Archæan mass carrying up with them the overlying sediments, and forming Mount Sedgwick and other elevations borne upon the plateau. The forms of these granite bosses, as well as the remarkable metamorphism of the immediately overlying carboniferous sandstone, would seem to suggest very strongly that they may be true laccolites. And this view relieves us of the necessity of accounting for the softening *in situ* of the Archæan so near the surface, since these bosses can never have been covered by more than ten thousand feet of strata. There is evidence that the basic eruptions which built up Mount Taylor and the volcanic caps of the mesas were subsequent to some part of the principal erosion of the country, though contemporaneous with a large part of it.

None of Captain Dutton's conclusions will interest the general student more than those relating to the formation of mountains. He traces a series of mountain forms from the extreme simplicity of structure disclosed in the Zuñi Plateau to the comparatively complex structure of the Wasatch and Basin ranges, and finds a generic idea running through them all. It is the idea that was taught us when we were school-boys, that mountains consist of granitic or metamorphic cores, with sedimentary strata upturned upon their flanks.

"Within the past twelve or fifteen years it has become a widely accepted view among the geologists of Europe and America that the forces which have elevated mountains are derived from the strains set up in the outer envelopes of the earth by the secular cooling and shrinkage of its interior; but it should be borne in mind that geological science has flourished most in those countries where the best known and most thoroughly studied mountains and ridges are greatly plicated. To the European geologist the Alps and the Jura have always been the most commanding and interesting of orographic structures. To the Briton the highlands of Scotland and Wales have been equally absorbing fields of research, in which the solution of the problem of mountain-building has been attempted. In America geology had its first and most rapid growth in the Appalachian region, and, when it sought fresh fields in the Pacific slope, it first found them in the Coast Ranges and in the Sierra Nevada. All of these regions are more or less plicated; and it is not to be wondered at that a universal conviction should have grown up that plication and mountain-building are only different names for one and the same thing, or that the process which built the mountains folded the strata at the same time. But as soon as the geologists penetrated the vast mountain-belt which lies east of the Sierra and west of the Great Plains, and proceeded to a careful study of the forms there presented, a wholly different state of affairs was revealed. Not a trace of a systematic plication has yet been found there. The terms 'anticlinal' and 'synclinal' have almost dropped out of the vocabulary of the Western geologist. The strata are often flexed, but the type of the flexure is the monocline."

"The Rocky Mountain region discloses whatever it has to tell us about physical geology with marvellous clearness and emphasis, but there is no teaching more clear or more emphatic than the absence of plicating forces from among the agencies which have built its magnificent ranges and hoisted its great plateaus. They have been lifted by vertical forces acting beneath them. The country at large shows no traces of a widespread, universal, horizontal compression; on the contrary, it discloses the absence of such stress."

These statements are undoubtedly correct, so far as the paleozoic and later formations, and the existing reliefs of the West, are concerned; and Captain Dutton probably did not intend that they should be applied to the Archæan strata of that region, since these are everywhere as strongly plicated as the rocks of any district on the globe. When these ancient crystalline schists of the Rocky Mountain region were folded up, mountains of the Appalachian type must have been formed. But these were largely swept away by erosion before the beginning of the grand cycle of events which Captain Dutton has outlined.

NOTES AND NEWS.

AT a meeting of the Biological Society of Washington, Dec. 17, an interesting paper was read by Mr. C. L. Hopkins on the sense of

smell in buzzards. This much-debated point was strongly set forth by Mr. Hopkins relating his experience in Florida. It was the uniform testimony of the Florida 'crackers' that buzzards obtained food by smell. He observed that buzzards never left their roosts on damp, foggy mornings until the ground and shrubbery were dry. They would then move slowly across the wind until a scent was struck, when they would work up the wind until the carrion was found. Sometimes they would drift down the wind, past their prey, until they struck the scent, which would be followed up, finding the object of their search sometimes in the densest scrub. He had on several occasions killed wild hogs in the scrub, and after dressing them, and taking what meat he wished, would see twenty or more buzzards coming down with the wind. On several occasions, covered offal had been detected by them. They had also discovered a buried snake. Several other instances were related, which, in Mr. Hopkins's opinion, conclusively proved that buzzards find some of their food by scent, though that did not preclude the possibility or probability that they obtain other food by sight.

— An interesting event took place at the Perkins Institute for the Blind at South Boston on Dec. 21. It was the celebration of the fiftieth anniversary of the entrance into that institution of Laura Bridgeman, the famous blind deaf-mute. Her first instructor, Dr. Samuel G. Howe, is long since dead; but his wife, Mrs. Julia Ward Howe, presided at the reception. The phenomenal education of Miss Bridgeman will always remain a monument of pedagogic skill. She lost her sight and hearing when two years old, and her taste and smell are both very defective. She speaks by making the manual signs of the deaf-and-dumb, and reads the similar motions of the 'speaker' by feeling the letters as they are formed. She does this with marvellous rapidity, and all the addresses were interpreted to her as they were delivered at the reception. Among the speakers were Dr. Edward Everett Hale and Dr. Phillips Brooks.

— The only railway extending into the Arctic zone runs north from the port of Lulea, in Sweden, at the head of the Gulf of Bothnia, toward the iron-mines of the Gellivara Mountains. The first train to cross the Arctic circle passed over this road a few weeks ago.

— Mr. J. A. Brashear gave an exhibition at his works, Allegheny, Penn., on Dec. 8, 9, and 10, of the large star spectroscope designed and constructed for the Lick Observatory, Mount Hamilton, California.

— The secretary of the committee for the organization of the American Folk-Lore Society, W. W. Newell, Cambridge, Mass., announces that the society will organize in a meeting to be held on Jan. 4 in Cambridge, Mass. The number of members amounts at the present time to two hundred, and, as the society has thus obtained an income sufficient to support a journal, it will begin work. The plan of organizing a society of this kind must recommend itself to all interested in the science of man. The scope of the society's work will be the study of the relics of Old English folk-lore, the lore of negroes in the Southern States of the Union, lore of the Indian tribes of North America, and that of French Canada, Mexico, etc. Furthermore, the study of the general problems of folk-lore, and publication of the results of special students in this department, will form one of the objects of the society. Our country is particularly adapted to the study of certain problems connected with folk-lore, such as the development of European and African lore in a new environment, and the origin of a new lore in mixed races. The material furnished by such researches is of prime importance for a study of the psychology of nations. It is hardly necessary to emphasize the fact that the collection of the rapidly vanishing remains of Indian folk-lore must be carried on vigorously, and on an intelligent plan, else it will be too late. The publications of the society will undoubtedly contain a vast amount of interesting material, and will amply repay the annual fee of three dollars. Our knowledge of the subject of American lore is still so slight, that almost any one who comes into contact with Indians, negroes, or the less educated white men, can make valuable contributions to this science; and therefore we would wish that the membership of the new society were thousands instead of hundreds.

— An interesting geographic sketch lies before us, which refers to a country but seldom described. It is Charles Bell's 'The Selkirk Settlement and the Settlers' (Winnipeg, 1887, 44 pp.), its contents being a concise history of the Red River Country of Canada from its discovery. It is also made to include local information from original documents lately discovered, and many biographical notes from old Selkirk colonists. A considerable portion of the pamphlet is taken up by the narration of the Selkirk colony's foundation under the leadership of Miles MacDonell, born in Inverness, Scotland, in 1769, and selected by Lord Selkirk in 1810 for the purpose above mentioned. The colonists started from Stornoway to the number of one hundred and twenty-five, and consisted of Londoners, Scotchmen, Irishmen, and inhabitants of the Orkney Islands. The party did not arrive at Red River, Manitoba, before August, 1812, and then set themselves to erect buildings on the west bank of Assiniboine River. The colony already exceeded the number of two hundred colonists, when in 1814 trouble arose with the employees of the North-west Company. Several bloody conflicts took place before tranquillity was restored, four years after. Numerous woodcuts contribute largely in enlivening our interest in the narrative presented by Mr. Bell.

— The explosion of a water-reservoir or boiler in the kitchen of the Kirby House, Milwaukee, recently was perfectly recorded in the vibrations given by the shock to a ruling-machine in the bindery of *The Sentinel*. The machine is directly opposite one of the windows of the bindery, and was in full motion when the explosion took place, drawing straight lines. The first impulse of the shock carried the pen nearly half an inch from the true line; then for some distance it approached the true line again without wavering, when it suddenly drew waving lines for the final reactionary vibrations. The lines are just such as are made by the seismometer in an earthquake shock.

— Recent soundings in Lake Leman and the Lake of Constance have shown that the beds of the Rhone and of the Rhine may be traced for a considerable distance on the bottom of the lakes. It is well known that the deposits of these rivers form a flat cone extending far into the lakes. On these cones embankments are found which enclose the bed of the river. That of the Rhine is cut into the deposits, while that of the Rhone is not deeper than the surface of the cone. F. A. Forel has studied these phenomena thoroughly. He determined the density of the water of the Rhone and of Lake Leman, and found that the former is almost throughout the year denser than the latter. A series of experiments on the influence of suspended matter upon the density of water shows, that, if the matter is moving vertically downward, the density of the mixture may be found by adding the weight of the suspended matter to that of the liquid, and dividing the total by the volume of the mixture. As the Rhone carries a great amount of suspended matter, the latter must be taken into consideration; and Forel's researches show that the density of the water of the Rhone, as dependent on its temperature and the amount of dissolved and suspended matter, is greater than that of the lake except during a brief period in spring. On the sides of the current, where it adjoins the stagnant water of the lake, the suspended matter is precipitated, and thus the dikes are formed. It is possible, that, in addition to this, the water of the rivers has a slight eroding action.

— On Dec. 1, Sir John Lubbock, we learn from *Nature*, read a paper before the Linnean Society, in continuation of his previous memoirs, on the habits of ants, bees, and wasps. He said it was generally stated that the English slave-making ant (*Formica sanguinea*), far from being entirely dependent on slaves, as was the case with *Polyergus rufescens*, the slave-making ant *par excellence*, was really able to live alone, and that the slaves were only, so to say, a luxury. Some of his observations appeared to throw doubt on this. In one of his nests the ants were prevented from making any fresh capture of slaves. Under these circumstances, the number of slaves gradually diminished, and at length the last died. At that time there were some fifty of the mistresses still remaining. These, however, rapidly died off, until at the end of June, 1886, there were only six remaining. He then placed near the door of the nest some pupæ of *Formica fusca*, the slave ant. These were at once carried in, and soon came to maturity. The mortality

among the mistresses at once ceased, and from that day to this only two more have died. This seems to show that the slaves perform some indispensable function in the nest, though what that is still remains to be discovered. As regards the longevity of ants, he said that the old queen ant, which had more than once been mentioned to the society, was still alive. She must now be fourteen years old, and still laid fertile eggs, to the important physiological bearing of which fact he called special attention. He discussed the observations and remarks of Graber as regards the senses of ants, with special reference to their sensibility towards the ultra-violet rays, and referred to the observations of Forel, which confirmed those he had previously laid before the society. Professor Graber had also questioned some experiments with reference to smell. He, however, maintained the accuracy of his observations, and pointed out that Graber had overlooked some of the precautions which he had taken: his experiments seemed to leave no doubt as to the existence of a delicate sense of smell among ants. As regards the recognition of friends, he repeated some previous experiments, with the same results. He took some pupæ from one of his nests (A), and placed these under charge of some ants from another nest (B) of the same species. After they had come to maturity, he placed some in nest A, and some in nest B. Those placed in their own nest were received amicably; those in the nests of their nurses were attacked and driven out. This showed that the recognition is not by the means of a sign or password, for in that case they would have been recognized in nest B, and not in nest A. Dr. Warsmann had confirmed his observations in opposition to the statement of Lespis, that white ants are enemies to those of another nest, even belonging to the same species: the domestic animals, on the other hand, can be transferred from one nest to another, and will be amicably received. In conclusion, he discussed the respective functions of the eyes and ocelli, and referred to several other observations on various interesting points in the economy of the social *Hymenoptera*.

— The reports of the German factory inspectors for 1886 contain some interesting statistics respecting the hours of labor, accidents, etc., in various districts and in different employments. On the whole, the number of work-people increased, in the fifteen districts for which reports are published, from 596,561 in 1884, to 642,386, being an increase of 33,496, or 7.7 per cent, of males, and 12,329, or 7.6 per cent, of females. The industries in which the chief increase took place were textiles, food, wood, and carving. There was a great decrease in the number employed in mining. In some districts there was a great lack of employment, while farmers were complaining that they could not find laborers to do their work. In Bavaria, in 29.4 per cent of all industries the hours of labor were from 11½ to 16 hours daily; in 59.6 per cent from 10 to 11 hours; and in the remainder from 11 down to 5 hours. The last-named time applied only to the work of putting the quicksilver on the backs of looking-glasses. Excessively long hours prevail in breweries, where they are never less than 16 hours a day. In the Düsseldorf district nearly 40 manufacturers of textiles have entered into a convention not to make the working-day longer than 12 hours. According to a regulation made in 1885, all accidents in factories must be brought to the knowledge of the inspectors. This accounts for the apparently enormous increase in the number of accidents: 2,394 were brought to the inspectors' notice during the year. These are arranged under two heads: (1) The causes; (2) The consequences to the victim. More than one-half are put down to inevitable accident, and more than one-third to carelessness and want of skill. More than four-fifths were attended only with temporary incapacity for work. The work-people appear to understand and enter into the spirit of the recent insurance laws; but it seems from the reports that the increase of children's labor, the night-work of women, and the prolonged hours of labor of women and children in certain places, are the next subjects connected with German labor that call for legislative regulation and interference.

— The attempt is being made to organize a debating club in the American Geographical Society for the purpose of discussing geographical questions and results of new investigations. It is hoped that all cultivators of geophysics, geography, commercial geography, and allied sciences, as well as teachers of geography and those interested in its study, will join the club. All intending to become

members of the club will please send their names and addresses to Dr. F. Boas, 47 Lafayette Place, New York.

— Mr. Montagu Kerr has left for Zanzibar to undertake a journey of some venture across Africa. Mr. Kerr has already done good work in Africa, in the journey which he made, almost single-handed, from the Cape to the Zambesi and Lake Nyassa, partly through new country and among some very troublesome tribes, whom he managed with great tact. In his present expedition, which he undertakes entirely at his own charge, Mr. Kerr means to proceed through Massai-land to the north end of Victoria Nyanza, and thence to Emin Pacha's station at Wadelai. His further course will be to some extent guided by Emin Pacha's advice; but his present intention is to proceed westwards to the Lake Chad region, where he hopes to do some good exploring work, and then, if possible, go on to the Niger and descend that river. Mr. Kerr has a strong letter of recommendation from the Marquis of Salisbury to the British consul at Zanzibar. It is possible that when he reaches Zanzibar Mr. Kerr may meet Mr. Stanley, or at least hear of the results of his mission, and may thus be led somewhat to modify his plans. But whatever course he may take, if he keeps his health, he is pretty sure to do some good work. He has, since his return from his last expedition, done every thing possible to qualify himself for scientific observation, and is quite prepared to pass muster as a Mohammedan in the most fanatical Moslem districts. Mr. Kerr is furnished with a set of instruments by the Royal Geographical Society. All who know him have confidence in his pluck and discretion.

— In the October *Monthly Weather Review*, the long drought of 1887 is discussed. During the six months from May to October inclusive, the rainfall has been largely deficient over the district between Dakota, Michigan, Kentucky, and Kansas. Less than one-half the usual amount of rainfall during these months has fallen in central Ohio. Less than three-fourths of the average amount of rain has fallen during these few months from Michigan, Ohio, and Kentucky westward, to include Missouri and Iowa. Of special interest is a compilation of excessive rainfalls in the month of October for a series of from ten to sixteen years. In a letter to the *Engineering News*, General Greely says, "It is the intention of this office to continue this discussion by months. A systematic effort has been made to make the data for succeeding months more complete and full than for October. In addition, the chief signal-officer has issued instructions to the observers, calling their especial attention to heavy rainfalls." The *Engineering News*, in an editorial, had emphasized the importance of measurements of heavy rainfalls; and in reply to this the chief signal-officer writes, that if the engineers of the country are in earnest about this matter, and will persuade Congress to appropriate twenty-five hundred or three thousand dollars for the purpose of buying self-registering rain-gauges, efforts will be made to spend the money economically, and to distribute the gauges so as to completely cover the country. It is very desirable that the plan should be carried out, as these observations, in connection with the gauge measurements published in the reports of the chief of engineers, would be highly valuable from a scientific as well as from a practical point of view, as the interval between excessive rainfalls and floods and the influence of the character of the rainfall upon that of the flood is of eminent importance for the low parts of the country and for the construction of roads, canals, and other works.

— The first number of *The American Geologist* has just been issued. It is stated in the prospectus that the journal will be devoted to geology in its widest sense, and to allied sciences in all those directions where their special investigations bear directly upon the constitution and history of the globe. A journal of this character will be highly welcomed by all interested in the subject; and, as the amount of geological work done in North America is very great, it will undoubtedly flourish, and become indispensable to students of American geology. The continuous increase in the number of journals devoted to special sciences is highly gratifying, as it is proof of a rapid progress of science, and as it prevents the scattering of investigations in one branch of science through numerous journals. The editors are Prof. S. Calvin, T. W. Claypole, Dr. Persifor Frazer, Dr. L. E. Hicks, E. O. Ulrich, Dr. A. Winchell, and

Prof. N. H. Winchell. It is published in Minneapolis. The first number contains interesting communications on the International Congress of Geologists, on geological problems and observations in Minnesota and Iowa, editorial comments, and a review of recent literature.

LETTERS TO THE EDITOR.

* Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith. Twenty copies of the number containing his communication will be furnished free to any correspondent on request. The editor will be glad to publish any queries consonant with the character of the journal.

The Mechanism of the Flight of Birds.

THE subject of the interesting letter by my friend Prof. J. S. Newberry in a late number of *Science* is an extremely important one, which has lately been discussed before the National Academy of Sciences and the Linnaean Society of New York, by Professor Newberry, Professor Trowbridge, and others. Much as I regret my absence on those occasions, I am still more sorry to be obliged to dissent without qualification from the position taken by these gentlemen, which is, to my knowledge, quite untenable. Since the matter has been published, I crave permission to state the facts in the case, and incidentally to present the very curious history of the discovery of the remarkable mechanism of flexion and extension in birds' wings, involving what I would call the 'precession and recession of the radius along the ulna.'

First. With regard to the alleged locking of the primaries: 1. It does not take place; 2. Did it take place, flight would be impossible.

Second. Extension of the carpo-metacarpus upon the antebrachium is automatically effected whenever the antebrachium is extended upon the brachium; and, conversely, flexion of the carpo-metacarpus upon the antebrachium is automatically effected whenever the antebrachium is flexed upon the brachium. In other words, the elbow and wrist of a bird work together, and neither can be bent or straightened to any considerable extent without the other being also bent or straightened. This motion, be it observed, in the cubito-carpal joint, is not flexion and extension in the usual technical sense of those terms, but is the movement commonly called, as in human anatomy, adduction and abduction. Moreover, the peculiar movement of the cubital bones (radius and ulna) which produces pronation and supination (as in man and many other mammals which use their fore-paws as hands) is reduced to a minimum, if not absolutely *nil*, in a bird's wing. It is just these points: (a) substitution of adduction and abduction for flexion and extension; (b) substitution of the lengthwise sliding back and forth of the radius along the ulna, or recession and precession, for that rolling sidewise of the radius upon the ulna which is pronation and supination; and (c) the reciprocal interaction of the elbow and wrist-joint, — it is just these points, I aver, which are the gist of the peculiar mechanism of birds' wings, so far as the bones themselves are concerned.

All these points are fully described, and illustrated by figures, in two of my works; namely, 'Proceedings of the American Association for the Advancement of Science, for 1871' (vol. xx., pub. 1872, pp. 278-284); and 'Key to North American Birds' (2d edition, 1884, pp. 106 seq.).

Third. The history of the case is curious, showing the quadruped discovery of the precession and recession of the radius by four independent observers: (a) Bergmann (1839), (b) Wyman (1855), (c) Coues (1871), (d) Garrod (1875). To take these up in reverse order:

(d) GARROD (A.H.), 'On a Point in the Mechanism of the Bird's Wing,' *Proceedings of the Zoological Society*, Feb. 16, 1875, pp. 82-84. [The gist of the paper is the peculiar sliding motion of the radius along the ulna. Garrod writes as an independent discoverer, as no doubt he was, or he would of course have referred to the previous writers.]

(c) COUES (E.), 'On the Mechanism of Flexion and Extension in Birds' Wings,' *Proceedings of the American Association for the Advancement of Science*, xx. for 1871, pub. 1872, pp. 278-284; abstract in *American Naturalist*, v. 1871, pp. 513, 514; reproduced in substance, *Key to North American Birds*, 1884, pp. 106 seq. [See text above. The writer, like Garrod, was ignorant when he made the discovery that any one had preceded him.]